DOE/NSF HEP PROGRAM REVIEW

Physics Department

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April 27, 2005

BROOKHAVEN NATIONAL LABORATORY

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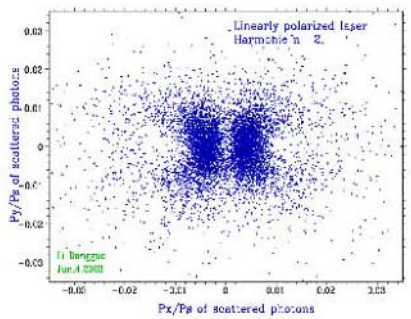
Physics Department Overview

- General Issues
- Budgets
- Experimental Activities
  - MINOS
  - D0
- Theory
- Concerns/conclusions

ATLAS, RSVP, Advanced Accelerator, ATF covered in other plenary talks



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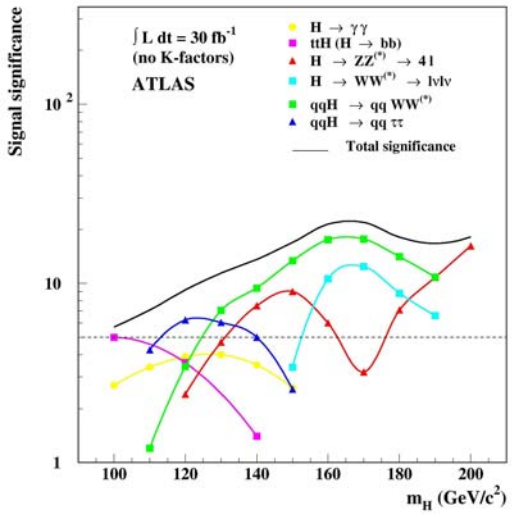
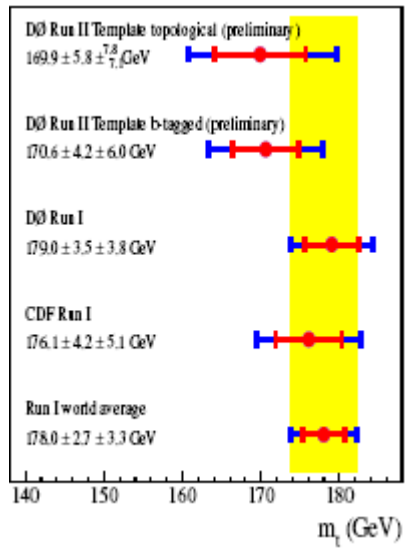
Science!

Science at the forefront



Looking forward to ATLAS physics

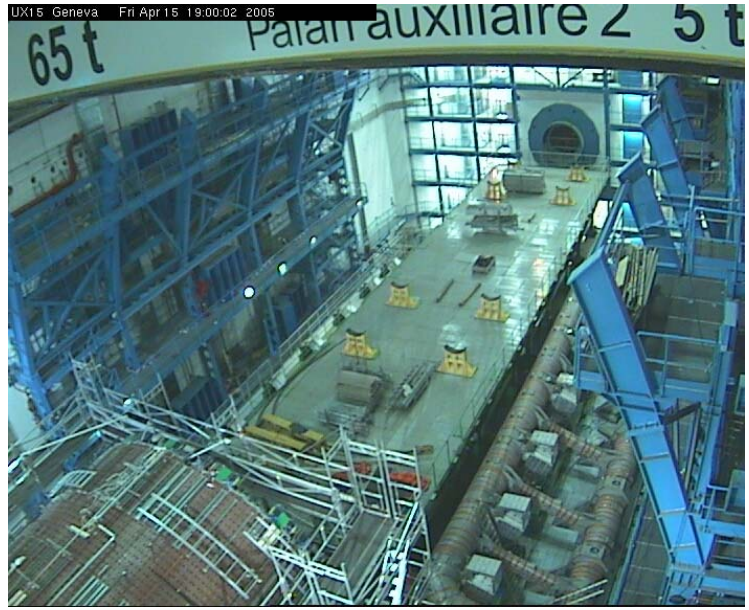
D0 analysis: top, B's, τ's



Searching for ν_μ disappearance, ν_e appearance at MINO

Exciting Physics At Energy Frontier

- ATLAS
  - Construction nearing completion and BNL's role has been a big success
  - LHC Research Program at BNL has a planned growth
    - M&O: Commissioning of many detector components
    - Computing software and hardware approaching full functionality to be able to exploit the physics
    - Separate funding from Physics Department core funding
  - BNL's Physics Analysis Center added two physicists in 2005

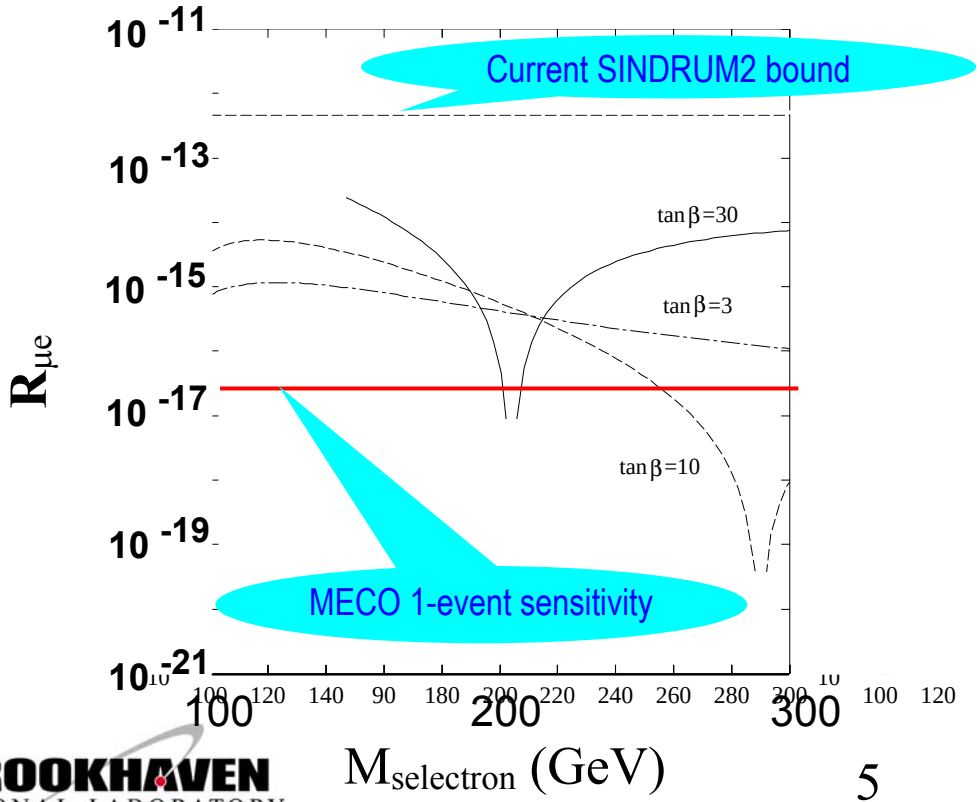


ATLAS is largest effort in Physics Department's HEP program

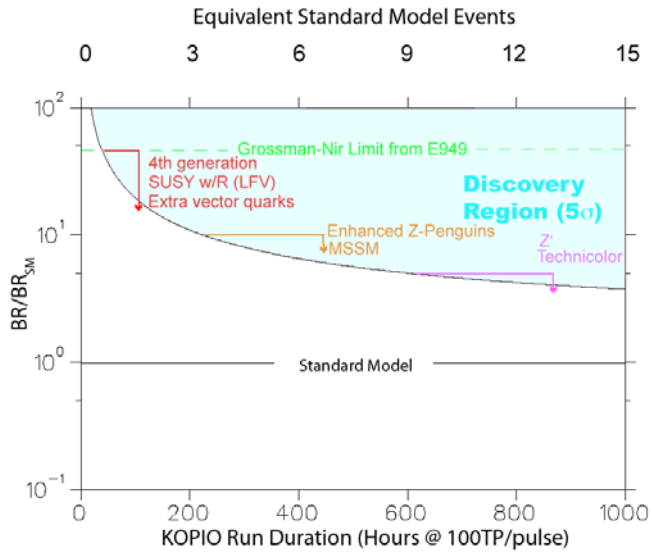
See talks by Gordon, Lissauer, Rajagopalan, Peggs (on LARP)

The Sensitivity Frontier with RSVP

MECO



K0PI0



Physics during initial phase

10% measurement of $K^0 \rightarrow \pi^0 \nu\bar{\nu}$

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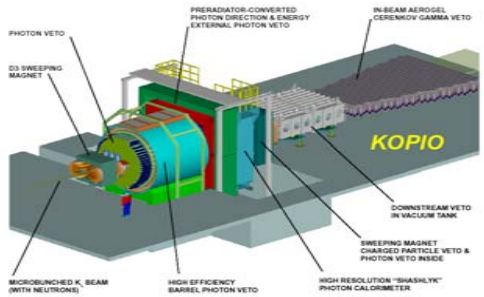
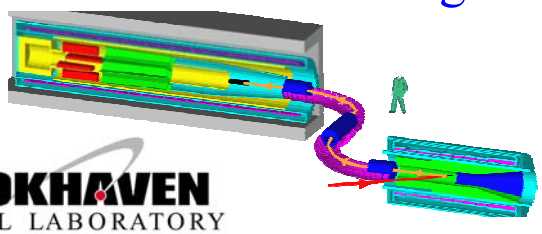
Looking Towards RSVP

- Construction and operations mainly NSF
  - HEPAP/NSF review of science
- Much activity on "baselining"
  - Review April 20-22, 2005
  - *Recommendation: Add people*

} Leading to construction start, Fall 05



- K0PI0
  - Physics department responsibilities are integration; vacuum vessel; barrel veto; preradiator; downstream veto
  - BNL Physics Department has central role in collaboration
- MECO
  - Physics department efforts center on muon beam design in order to minimize backgrounds and insure beam extinction

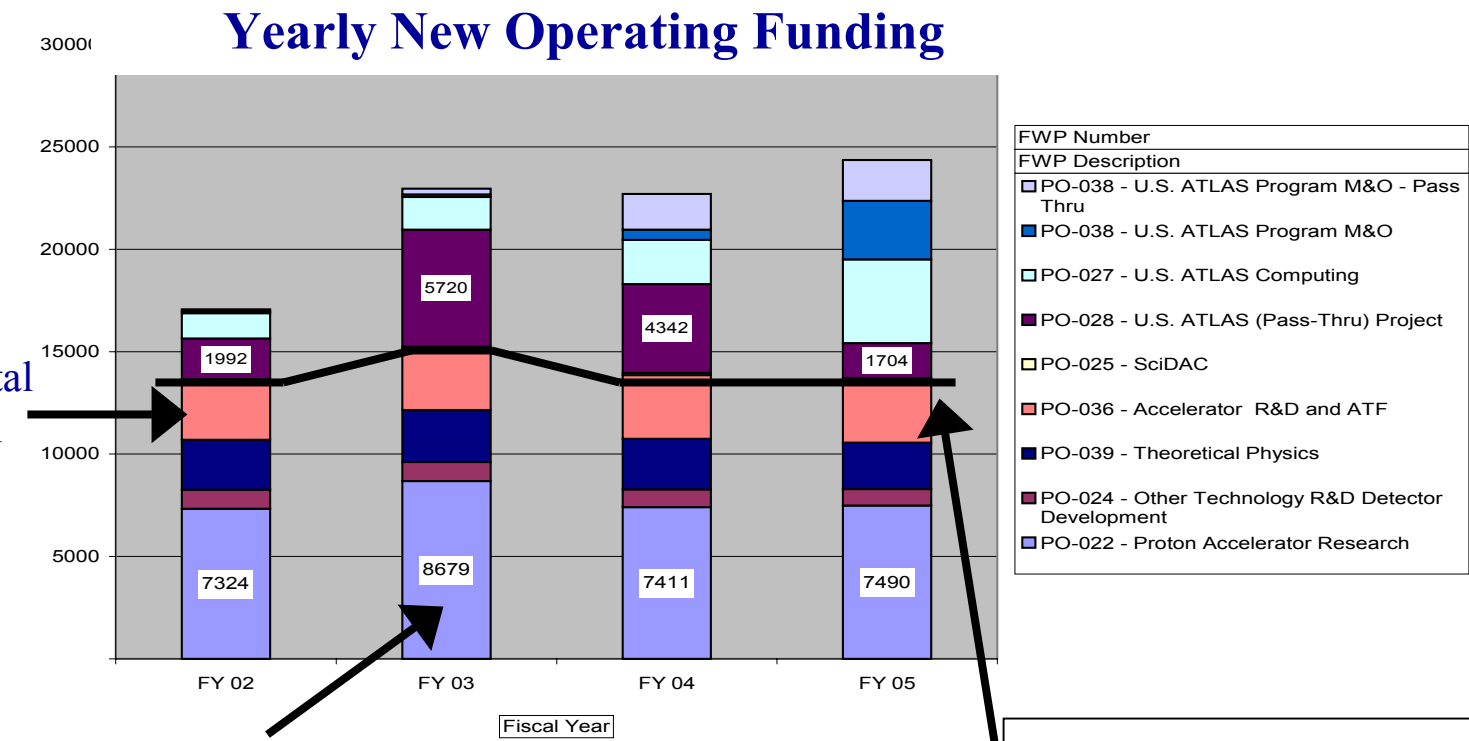


See talks by Kotcher, Jaffe, Semertzidis, Pile

Physics Department Priorities

- Experiments: ***ATLAS, RSVP, D0, MINOS*** – nothing else currently supported by DOE HEP funding
  - Painful process creating highly focused program, with priorities
  - Support for E949 terminated
  - D0 will transition to ATLAS in 2007
  - g-2 upgrade and extension has been submitted to OHEP
    - No BNL Physics Department support currently
- Theory: Internationally strong
  - Centered on phenomenology and lattice gauge theory
  - Program has shrunk
- Accelerator R&D
  - Advanced Accelerator R&D and ATF
- Detector R&D – aimed at developing new experiments
  - Unique partnership with BNL's Instrumentation Division

Physics Department Funding Trends



ATF joined physics in 02, total funding included

Spike due to large transfer of capital funds

Note gradual erosion of core program; total non-LHC $'s is below dark line

Only operating funds, only new funds allocated each year, then year dollars

FY05 Budget Problems

KA1101020- Proton Research		
Carryover Funds from FY 04	$639K	
Oct Financial Plan	$6840K	
Add'l allocations/capital swap*	$650K	
Project FY 05 Funding		$8129K
Initial Cost Plan	$8569K	
Reduce Labor	-$135K	
Reduce MST	-$150K	
Projected FY 05 Costs		$8284K
Current Projected Shortfall		-$155K

Major source of core program funding

$250K supplement for ATLAS physics
$400K EQU→OPE

RIFs + redirection of labor

- 4-6 RIFs in June, 05

Still a problem

What do we do?

Staff levels (FTE's)

Physics department staff only

		phys	comp prof	eng	techs	admin	students	others	TOTAL
FY04									
	LHC - project	1.7	11.7	8.3	5.5	2			29.2
	LHC - research	8.9		2	1.6	1	0.3		13.8
	RSVP	8.5		0.6	2.9	0.7			12.7
	D0	5.5					0.3		5.8
	Neutrinos	1.2				0.3			1.5
	Theory	8.8				1			9.8
	Accelerator R&D	4	0.9	5.4	1.9	1.2			13.4
	Detector R&D	2.4		1					3.4
	g-2	1			0.7				1.7
	FY04 Total	**42**	**12.6**	**17.3**	**12.6**	**6.2**	**0.6**	**0**	**91.3**
FY05 *									
	LHC - project	2.9	15.1	7.6	6.7	3			35.3
	LHC - research	9.8		0.5	0.4	1			11.7
	RSVP	9.4		1.1	2.6	1			14.1
	D0	3.1							3.1
	Neutrinos	1.8							1.8
	Theory	8.2				1.3			9.5
	Accelerator R&D	3.9	0	4.8	2	0.6			11.3
	Detector R&D	2.5		1.5					4
									0
	FY05 Total	**41.6**	**15.1**	**15.5**	**11.7**	**6.9**	**0**	**0**	**90.8**

- "LHC Project" includes both Construction ↓ and the Research Program ↑
- Note ATLAS growth in computing professionals
- D0 reduced
- Neutrino group partially supported by LDRD and department overhead is actually ~4 FTEs
- Accelerator R&D includes ATF (6.8) and Advanced Accelerator Group (4.5)

LHC project is growing

Biggest Issue is Physicists

- ATLAS physics analysis center needs to grow to maximize physics output
  - Would like to capitalize on investment in computing and software
- RSVP
  - BNL is leader in K0PI0 experiment
  - 3 K0PI0 sub-system managers are BNL junior staff
  - MECO has only 2.5 physicists from BNL
  - Support of these physicists crucial for success of experiments

Total physics high energy staff (includes LHC project) shows gradual decrease:

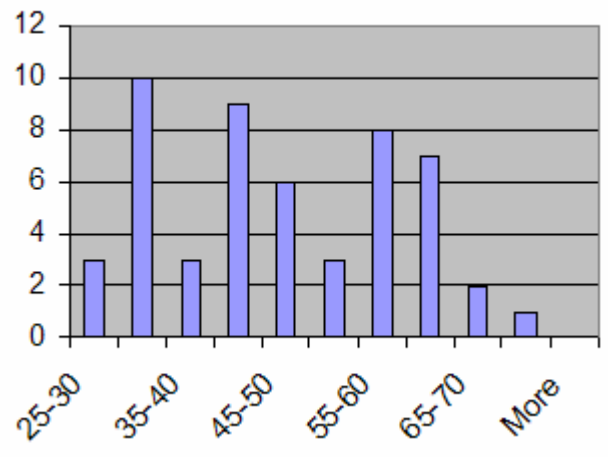
FY01	FY02	FY03	FY04	FY05	FY06	FY07
103.8	101	89.6	91.3	90.8	84.1	88.0

Assumes 5% increase from FY06 to FY07

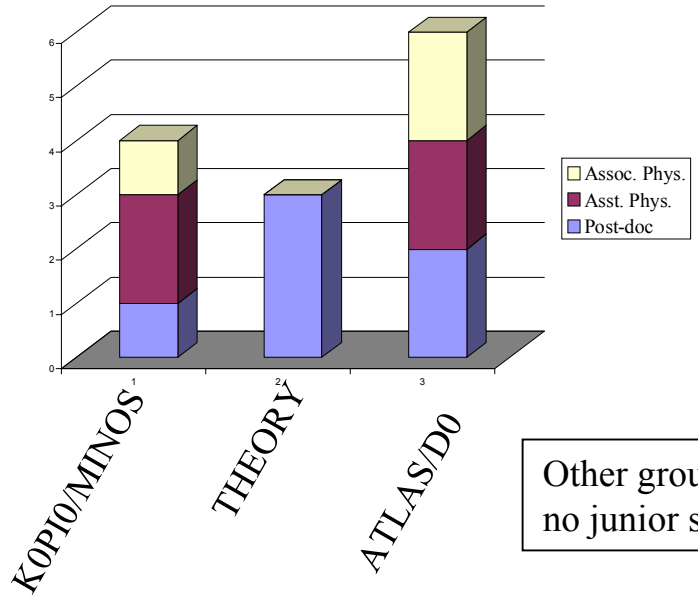
Assumes flat-flat from FY05 to FY06

Challenge to Nurture Young Physicists

Age distribution of HEP Staff



Junior Staff



Other groups have no junior staff

➢ Many spectacular young physicists in department:
See talks by Bishai, Jaffe, Krupovnickas, Yakimenko*

* All non-permanent staff

FY06 Budget

- Guidance for FY06 is $1,037K below that needed for constant effort in FY06 after FY05 RIFs
  - Requires ~ 7 additional RIFs in FY06
- Serious problem
  - ***We cannot support all our current activities with this budget***
  - No good solution

Choices to reduce staff by 7 FTEs in FY06:

- Physicists who are non-LHC project (FTEs):
  - 9.8 LHC research *Discoveries await*
  - 9.4 RSVP (2 supported by lab in 06) ***Reviews: Add people / strong BNL group crucial***
  - 3.1 D0 ***We are contributing to great physics, but will transition to ATLAS in 2007***
  - 1.8 Neutrinos (2 others supported by lab) ***Crucial contributions to MINOS; path to future ν program***
  - 8.2 Theory *Extraordinarily strong; leaders in collider physics*
  - 1 ATF ***Unique accelerator facility***
  - 2.9 Advanced Accelerator *Part of international μ program*
  - 2.5 Detector R&D ***Investing in the future***

*** Very little non-physics staff, most in ATF**

D0 at BNL

- Data from D0, in addition to leading to discoveries, directly helps BNL plan for ATLAS physics
- BNL's service activities in D0
  - Forward PreShower (FPS) software for on-line monitoring
    - Offline reconstruction and analysis is fully operational
    - BNL group is responsible for FPS hardware and software maintenance
    - New code being developed to use in Level 2 triggers.
  - Development and testing of τ triggers, software, identification, and analysis
- Group reduced by two physicists from FY04 to FY05
- BNL group has 3.1 FTEs (Patwa resident at FNAL/Snyder transitioning to ATLAS)

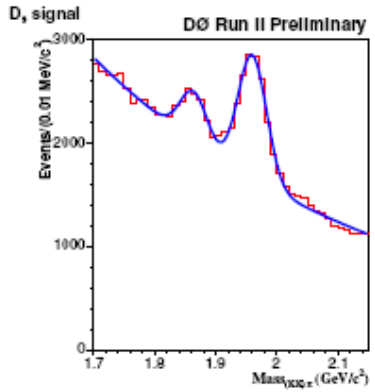
D0 Physics at BNL

- D0 recorded 0.66 fb $^{-1}$, up to .45 fb^{-1} used in analyses
- BNL D0 physics analysis:

  -B_s mixing lifetime studies

  - Use asymmetry between opposite and equal sign tags to measure Δm_s

  - $\sigma(Z \rightarrow \tau^+\tau^-) = 237 \pm 15$ (stat) ± 18 (sys) ± 15 (lum) pb
  - cf SM: 242 ± 9 pb
  - SUSY τ signatures



$B_s \rightarrow \mu\nu D_s \rightarrow \varphi\pi$

$\Delta m_s > 5.0$ ps^{-1}

- Top quark mass editorial board (Protopopescu, Patwa, Snyder)
  - New top quark mass coming soon : 400 pb^{-1} with matrix element method
  - $? \pm 3.0$ (stat) ± 2.6 (syst)

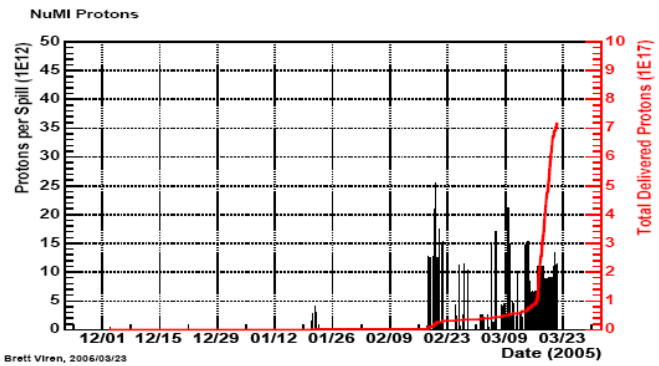
See talk by Protopopescu

MINOS at BNL

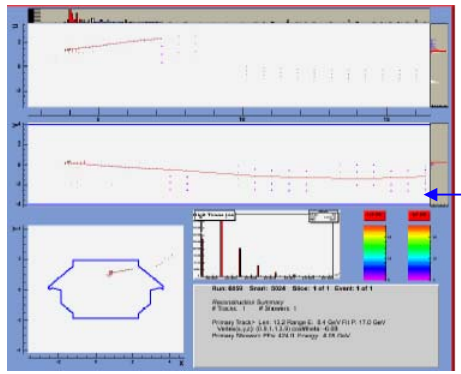
- We have grown this group to ~ 4 FTEs by supplementing DOE funds with Lab and Physics Department funds

- BNL's MINOS group is making crucial contributions to experiment:
  - Offline software, including event display
  - Interactive data analysis and database
  - Muon and hadron beamline monitors commissioning
  - NuMI beamline data logging

Offline beam data logging



Event display and reconstruction developed at BNL



Near detector, 1st beam neutrino, Jan 21, 2005

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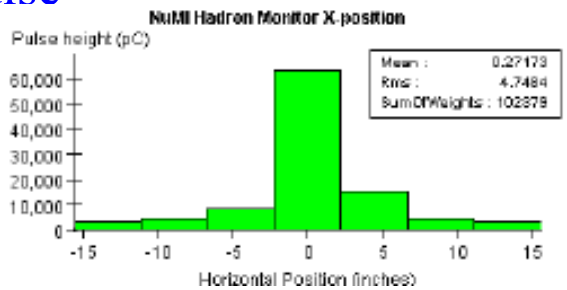
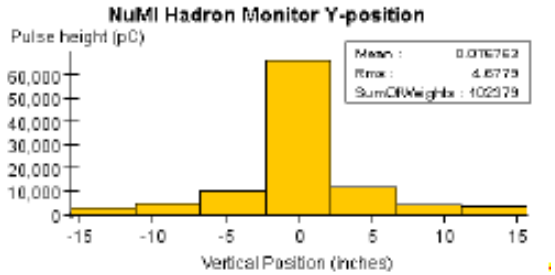
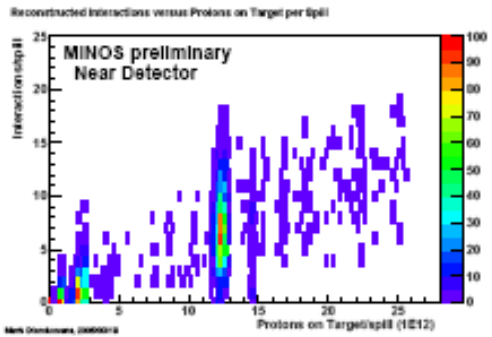
MINOS at BNL

- NuMI beam monitoring
- Dec 3, 2004 first proton sent down NuMI beamline without target
  - JAS NuMi monitor detected proton beam in hadron monitor on 12th pulse





- Looking forward to physics with near detector



➢ ν interactions in near detector vs protons on target

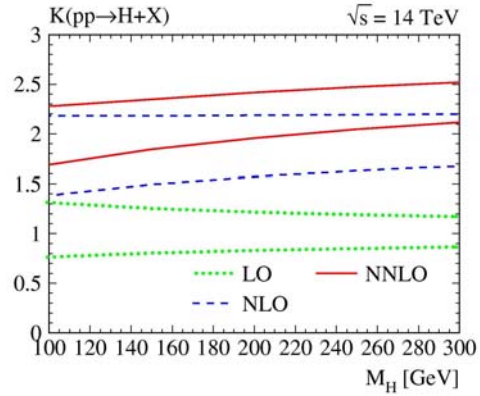
High Energy Theory

- Senior staff: Creutz, (Dawson), Kilgore, Marciano, Paige, Soni, Trueman (1/2 time)
  - Post-docs: Chen, Krupovnickas, Suprun
  - Pisarski moved to nuclear physics
- The group has shrunk by 2.5 FTEs since 2001
- Group is oriented towards experimental results
  - Hadron colliders and ILC
  - Higher order QCD corrections
  - Monte Carlo simulations for SUSY at the LHC
  - ν physics
  - Muon physics: g-2
  - Lattice gauge theory for weak interaction matrix elements and the role of fermions

Theory group closely connected to LHC Program

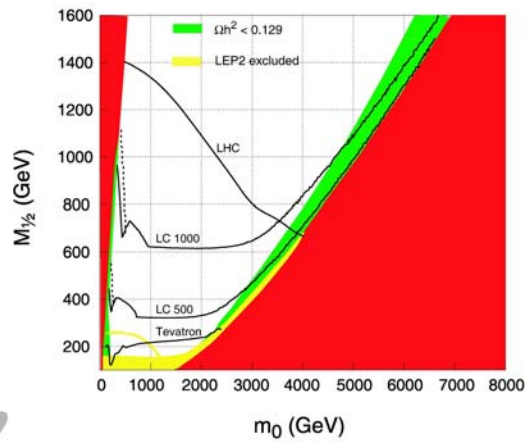
- 130 people at TeV4LHC workshop at BNL organized by theory group
  - Bringing together theorists and experimentalists

- Higher order corrections to Higgs production
  - Implementation into NNLO Monte Carlo in progress



- SUSY phenomenology at the LHC

- Radiative corrections and limits on new physics



BNL is a Center for Lattice Gauge Theory

- Efforts in both high energy & nuclear physics
  - Frithjof Karsch formed nuclear theory lattice group 2/05
- Two forefront machines dedicated to lattice gauge theory at BNL
  - Machines utilize QCDOC (QCD on a chip) architecture
  - Power PC nodes connected in a 6 dimensional torus
  - Processor/memory/communication on a single chip
    - RBRC machine complete; DOE machine complete 4/05
  - 10 teraflops peak; 5 teraflops sustained (per machine)
    - 12,288 processors/machine

Calculations in both high energy and nuclear physics: HEP effort centers on weak matrix elements

See talks by Creutz, Soni

Accelerator Physics in Physics Department

- Accelerator Test Facility is user driven facility (see talk by V. Yakimenko)
  - World class accelerator science
    - High brightness electron gun (world record)
    - 75 MeV linac
    - High powered lasers synchronized at picosecond level
  - Operates ~1000 hours/yr
  - No flexibility to enhance manpower
- Advanced Accelerator R&D (see talk by R. Palmer)
  - Part of national muon program

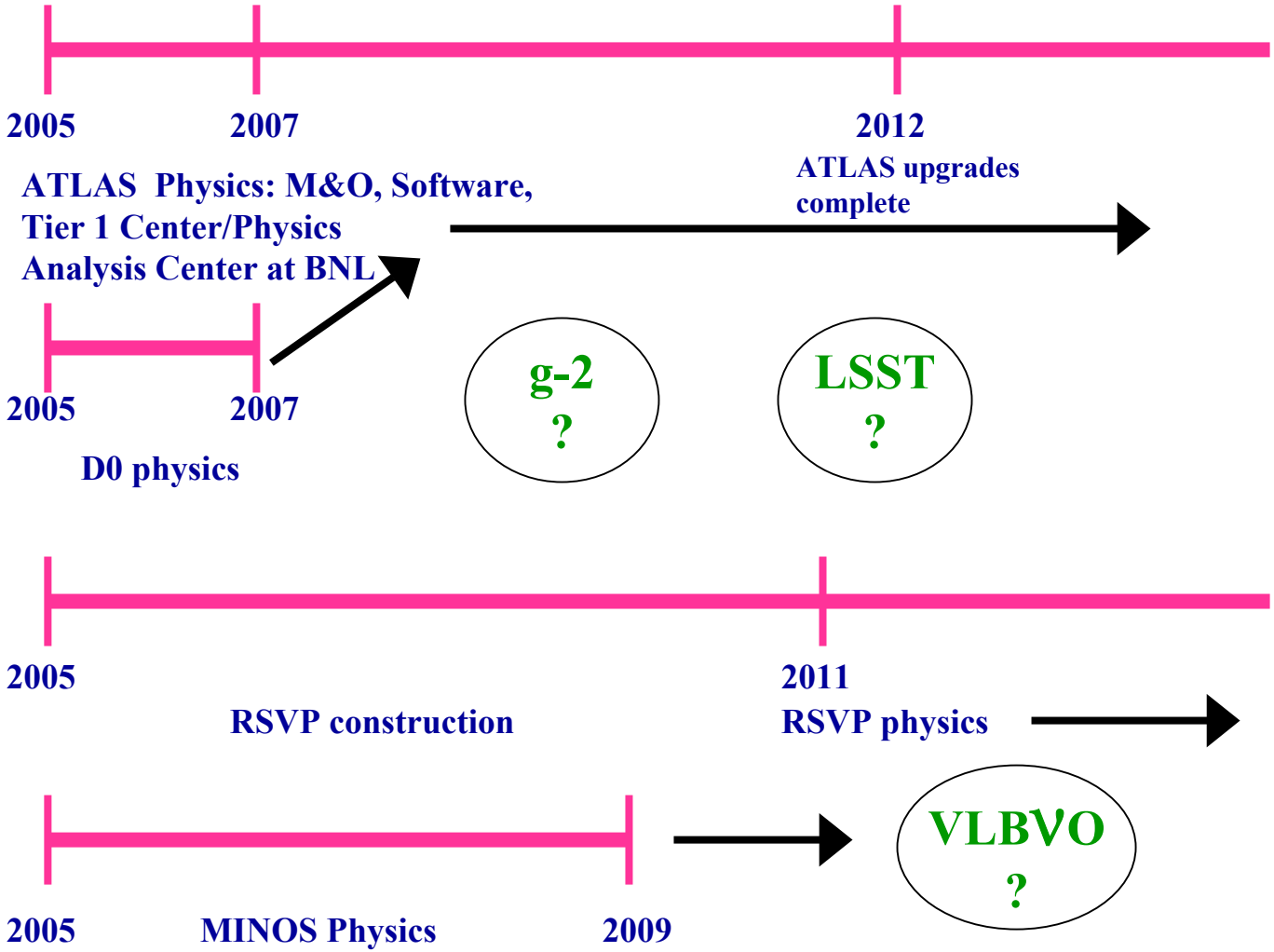
The Future

- LSST
  - Natural role for BNL in camera and data management
  - Exciting science
  - Needs DOE funding (see talks by S. Aronson/M. May)
- Very Long Baseline ν oscillation
  - Progress in simulations
  - Proposal for detector R&D (see talk by M. Diwan)
  - ν group supported by LDRD and department overhead; needs DOE funding

Conclusions

- We have crafted a highly focused High Energy Physics program completely aligned with the national priorities
- Looking forward to great discoveries in our HEP program
- However, we are challenged by the fiscal realities
- We have made some hard decisions and more will need to be made soon

BNL has a long future in HEP



Backup Slides

Physics Department Funding in FY04 and FY05

		Fiscal Year	
FWP Number	FWP Description	FY 04 Actual Expenditures $k	FY 05 Projected Expenditures $k
PO-022	Proton Accelerator Research *	7879	8284
PO-024	Other Technology R&D Detector Development	870	848
PO-036	Accelerator R&D and ATF **	3063	3078
PO-039	Theoretical Physics	2460	2251
Totals		14273	14462

* Includes FY 04 Carryover

** Includes combined B&R's

FY06 Guidance, $12,608